DRAFT – 1/31/01

MPS – Vacuum System Interface Requirements (WBS 1.4.2.4, WBS 1.5.5)

The Vacuum system should turn off the beam under two conditions: a vacuum valve is closed due to poor vacuum, operator command, or system failure, and if the vacuum conditions in a particular beam line are out of the acceptable running limits. The vacuum system inputs to the Machine Protection System will use the Beam Permit Inputs. These inputs latch in the OFF state until an operator resets the condition.

It might be desirable to have the vacuum inputs from the Cavities go into the Fast Protect System where the inputs are reset automatically the next pulse, or as soon as the input is satisfied. This would impact the grouping of signals in the super conducting linac.

Vacuum system inputs to the MPS may be combined as long as the conditions causing the valve to close are logged and the devices that are combined do not cross a Machine running mode boundary. The Machine Protection System will mask out inputs from devices not required for a particular machine running mode. The machine running modes are as follows:

- Front End – All devices from the source to the end of the MEBT.
- Linac Dump - All devices in the, DTL, CCL, SRF, and HEBT to the Linac Dump, including the Linac Dump window vacuum. Devices after HEBT:DH1 in the HEBT are excluded.
- Injection Dump – All devices after and including HEBT:DH1 in the HEBT, devices in the injection straight section of the ring, and devices in the injection dump line.
- Extraction Dump – Ring Lattice devices excluding injection straight section, RTBT devices up to RTBT:DH13, and devices in the EXTDUMP line including the window vacuum..
- Target – All devices after RTBT:DH13.

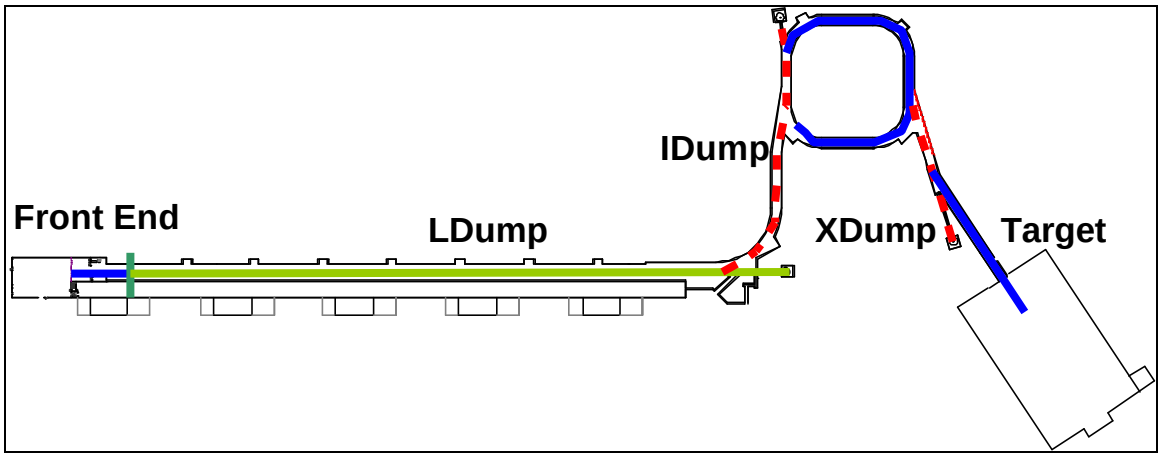

Figure 1. Beamline Modes

Vacuum – MPS Fault Condition Requirements

Fail Safe – Any inputs to the MPS should be fail safe, if the system providing the input goes out of service, is rebooted, etc. the MPS input should go into the fault state. If an IOC is used to provide the interlocking, the IOC heartbeat in the MPS board should be used to shut down the beam during a reboot. If a PLC is used to control the MPS input, the MPS signal should go into the fault state if the PLC is in Program mode.

Gate Valves – The input to the Machine Protection System should go into the fault state before a valve becomes the limiting aperture of the beamline in question. The closing speed and type of valve varies depending on the section of the machine. The beam must be turned of before the beam hits the valve and causes possible damage. The time involved includes the PLC processing time. If the processing time for the signal is too long, the valve contact indicating an "OPEN" position should be wired directly to the MPS as shown above.

Fast Valves – The fast valve controllers should generate an MPS fault directly to the MPS without going through a PLC.

Vacuum Levels – There needs to be an application running in a PLC, IOC, or workstation to monitor vacuum levels, trip points, and beam time in area's with vacuum less than desired. The system should have separate trip levels and allowable running times in different bands of vacuum levels. The times involved and vacuum trip points will be determined by Operations.

Vacuum Levels in SRF – The cavity and coupler vacuum requirements stated that a 1 msec time response is required from detection of a vacuum excursion to shutting off the beam. The maximum beam macro pulse length is 1 msec so the time allowed for a shutdown is 16-msec. or the maximum pulse rate of the machine.

Vacuum Level Requirements

Threshhold	System	Document	
$5x10^{-7}$	Front end systems	WBS 1.3 Front End Systems SRD	
$5x10^{-8}$	MEBT-DTL interface	"	
$1x10^{-7}$	DTL	SNS Linac Systems SRD	
$5x10^{-8}$	CCL	"	
$1x10^{-9}$	SRF	SCL Vacuum System Interrupts (1)	
$1x10^{-8}$	Coupler	"	(2)
350 torr	LDUMP Window	?	(3)
$5x10^{-8}$	HEBT	Ring and Transfer lines	(4)
$1x10^{-9}$	Ring	Ring and Transfer lines	
$1x10^{-8}$	RTBT	Ring and Transfer lines	
350 torr	XDUMP Window	?	(3)

(1) Gate valves close if vacuum > $1x10^{-9}$ longer than 3600 seconds or > 10^{-6} ASAP.

(2) Inhibit RF and Beam if pressure $>10^{-8}$ for 10 seconds, 10^{-7} for 1 second, or 10^{-6} ASAP.
(3) Pressures between the double windows in the Linac Dump and the Extraction Dump will be monitored for loss of pressure indicating leak into the beam line vacuum or increase in pressure indicating a leak from the Dump Helium line.
(4) Estimated losses due to H- stripping (50% H $\sigma \sim 10^{-19}$ cm2/atom, 50% Oxygen,Nytrogen $\sigma \sim 10^{-18}$ cm2/atom) is 0.18 nA/m

Cabling Requirements

It is the responsibility of the Vacuum Group for running the cable for the MPS signals to the IOC containing the MPS equipment. Testing the vacuum MPS signals to the IOC is also the responsibility of the Vacuum group. The connector on the MPS chassis is TBD. Pins 1 and 3 carry the MPS signal, pins 2 and 4 are used to determine if the input is connected.

The standard MPS input circuit is shown below.

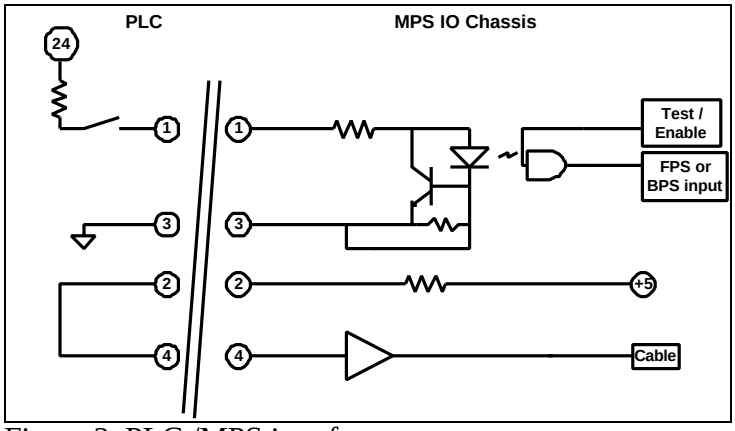

Figure 2. PLC /MPS interface

MPS checkout:

The vacuum system needs to operate the valves or change trip points to verify the inputs to the MPS. The command to close a valve should cause a fault input to the MPS. Changing the trip point of the vacuum system to below the present vacuum reading should also cause a valve to close and the input to the BPS to indicate a fault.